SECTION 3 – CIRCULATION AND WATER TREATMENT SYSTEMS

Aquatic facility water may be contaminated by a variety of pollutants from a number of sources. There are many factors that contribute to the contaminant loading on a water body including (but not limited to) bather load, water depth, temperature and the activities for which the facility is used.

The pollutants may be accompanied by a range of micro-organisms, some of which have the ability to survive and multiply in the water and produce infections in patrons. Pollutants can also produce high levels of turbidity in the water. This can make the water aesthetically unappealing to patrons, interfere with the disinfection process and make detection of submerged patrons difficult.

Aquatic facilities require water treatment systems that can effectively remove pollutants and micro-organisms from the water. The treatment systems need the capacity to draw an adequate volume of contaminated water from the water body, efficiently remove pollutants, dose the water with the required level of disinfectant and distribute the filtered and disinfected water back through the water body.

The more heavily loaded a body of water, the more rapidly this water must be treated to remove contaminants. The “Water Body Loading Category Chart” (Table 4) is designed to establish the parameters of different levels of contaminant loading, and specifies a Maximum Permissible Turnover Time for each category of facility.

3.1 GENERAL REQUIREMENTS

The design of the aquatic facility and water treatment system shall be in accordance with the intended use of the facility and the anticipated bather loadings. At the time of application for approval, proponents of facilities shall nominate the required Bather Loading and proposed classification for each water body in the facility, in accordance with Table 4.

Table 5 "Water Body Parameters by Category Chart", specifies the water treatment requirements for each water body in a facility. The water treatment plant for every aquatic facility shall be designed and operated in accordance with the approved classification of the water bodies in the facility, and the requirements of Table 5.

Every aquatic facility shall be provided with a circulation system consisting of one or more pumps, piping, suction outlets, return inlets, filters, disinfectant feeders, automatic water chemistry controls and other equipment necessary to maintain the specified water quality.

The circulation system shall be designed in accordance with the following requirements:

- The capacity shall accommodate 100% of the design flow rate (under clean filter conditions).
- The system shall be capable of providing effective mixing of water in the water body and uniform water quality.
- The system shall be capable of maintaining the specified disinfectant residual throughout all parts of the aquatic facility.

Aquatic facility water treatment systems shall be in continuous operation whenever a facility is available for use, and at such additional times and periods as may be necessary e.g. when an aquatic facility is closed during off season to maintain the water in a clean and disinfected condition.

This requirement applies to pumps, filters, disinfectant and chemical feeders, flow indicators, gauges and all related parts of the water treatment system.

[Section 3.1 amended 15 April 2010]

Table 4 – Water Body Loading Category Chart

Category	Loading Classification	Parameters	Water Depths	Examples	Maximum Permissible Turnover Times
1	Spas	Spa Pools		Spa Pools, Leisure Bubble Pools	**15 mins**
2	Extreme	Very High Bather Load, Very Shallow Water	"Very Shallow" 0m – 0.3m	Toddlers Pool, Water Slide Splashdown Pool	**30 mins**
3	Very High	Very High Bather Load, Heated Water, Shallow Water	"Shallow" 0.3m – 0.80m	Shallow Leisure Pool, Hydrotherapy Pool	**1 hour**
4	High	High Bather Load, Heated Water, Moderately Shallow Water		Medium Depth Leisure Pool, Learn to Swim, Wave Pool	**1 ½ hours**
5	Moderate	High Bather Load, Heated Water, Medium Depth Water	"Medium" 0.80m – 1.40m	Full Depth Heated Leisure Pool, Lazy River, Medium Depth Unheated Outdoor Leisure Pool	**2 hours**
6	Light	Medium Bather Load, Heated Water, Medium Depth Water		Heated School Pool, Health Club Pool, Body Corporate, Caravan Park, Motel Pools Full Depth Unheated Outdoor Leisure Pool	**2 ½ hours**
7	Low	Low Bather Load, Deep Water	"Deep" 1.40m – 2m	50m Competition Pool, Unheated Municipal/School/Motel etc Pool	**3 ½ hours**
8	Very Low	Very Low Bather Load, Very Deep Water	"Very Deep" >2m	Diving Pool, Water Polo Pool	**5 hours**

Example:

For Unheated Outdoor Pools, the Category/Loading Classification may be increased by one when compared to an Indoor Heated Pool with the same bather load. So, a Category 4 Pool (Heated Indoor with a High Bather Load and Moderately Shallow Water) could become a Category 5 Pool, if it was Outdoors Unheated with the same bather load and depth.

[Table 4 amended 21 September 2009]

3.2 CIRCULATION - SUCTION AND RETURN POINTS

3.2.1 General Requirements

Aquatic facilities shall be provided with a surface skimmer or perimeter overflow gutter system, which shall be designed and constructed to provide effective removal of soiled surface waters.

Facilities shall be provided with return inlets and suction outlets, which are arranged to produce a uniform circulation of water throughout the facility. Where applicable, circulation equipment, and controls may be installed to allow additional circulation to heavily loaded parts of a water body (e.g. a beach area).

A minimum of two return inlets shall be provided for every pool, that shall be sized and installed to accommodate the flow rate required by section 3.3.2 Filtration Rates and Turnover Times. The flow rates through a single return inlet shall not exceed manufacturer's recommendations.

Where a facility is greater than 12 metres wide, or more than 280 square metres in surface area; floor inlets, or a combination of floor and wall inlets, shall be used.

Where skimmer boxes are used, the return inlets shall be of a directional design and be located to assist in bringing floating particles within range of the skimmers. Return inlets shall be installed no further than 13 metres from the nearest skimmer.

3.2.2 Wall Inlets

Wall Inlets shall be rounded and smooth, tamper-proof and of a design to prevent entrapment. They shall not extend further than 2.5cm from the wall.

3.2.3 Floor Inlets

Floor inlets shall be installed flush with the surface of the bottom of the facility, be tamper-proof and of a design to prevent entrapment.

3.2.4 Surface Skimmers

Surface Skimmers may be used in aquatic facilities where the water surface area does not exceed 450 m^2.

Surface Skimmers shall be located in an appropriate position in relation to the inlets, to maintain effective skimming action throughout the facility.

The flow rate through surface skimmers shall not be less than 5 litres per minute, per centimetre of skimmer weir. The flow rate through each individual skimmer shall not exceed the manufacturer's maximum specified flow rate.

Skimmer covers located on a walking surface shall be securely seated, slip-resistant, of sufficient strength to withstand normal deck use, and not constitute a tripping hazard.

At least one skimmer shall be provided for every water body. More skimmers and suction outlets shall be installed as required, to ensure adequate circulation of the water body in accordance with Table 4 -Water Body Loading Category Chart. Flow rates through skimmers and suction outlets shall not exceed the manufacturer's recommendations. *[Section 3.2.4 – Surface Skimmers amended 31 Oct 2007 & 15 Sept 2008]*

3.2.5 Perimeter Overflow Systems ("Fixed Rim Skimming Device")

Perimeter overflow systems shall be used in aquatic facilities where the water surface area for an individual water body or a series of water bodies connected by the same filtration and circulation system exceeds 450 m^2.

Perimeter overflow systems shall be continuous around the water body and achieve 50% minimum perimeter coverage, given that the following areas are exempt from perimeter overflow system installation:

- At stairs,
- At recessed ladders,
- Directly under slide flumes,

- Along weir features,
- At raised ends,
- Along planter boxes *and*
- The walls of river rides/turbo channels.

They shall be designed with sufficient capacity to accommodate the volume of water to achieve the required turnover rate, together with any surge produced from patron activities, so that water is not permitted to flow onto the aquatic facility concourse.

All grates shall be neat fitting, with no gaps between adjoining grate sections, flush fitting, with no raised or buckled area. *[Section 3.2.5 Perimeter Overflow Systems ("Fixed Rim Skimming Device") amended 15 Sep 2008]*

3.2.6 Entrapment Prevention

Surface skimmers and perimeter overflow gutter systems shall be designed and installed so as not to constitute a hazard to the user, and to prevent entrance or entrapment of a patron's limb, body or hair.

The requirements of AS 1926.3, *Swimming Pool Safety, Water Recirculation and Filtration Systems shall apply to all suction outlet systems.* Furthermore the following items shall also apply:

Main drain outlets that are less than 300mm wide shall be covered with an anti-vortex grate.

Suction outlets shall not be able to be isolated, such that one outlet serves as the sole source of water to a pump.

The circulation systems of pools, spas or water recreation attractions shall not be operated if the main drain grates, or any suction outlet cover or grate is missing, broken, or insecurely fitted.

[Section 3.2.6 amended 7th July 2011]

3.3 WATER TREATMENT

Effective water treatment requires a combination of processes working together to provide water that is safe to swim in and of optimum quality. Among these, filtration and disinfection are critical processes with specific requirements.

3.3.1 Filtration

Filtration is used to remove contaminants that are present in the water, either as colloidal solutions or suspended as particulate material.

The filtration system pumps soiled water through a filtration medium, which captures and retains the contaminants. The filtration medium may consist of sand, diatomaceous earth or other approved material. The captured contaminants are subsequently removed from the filter medium during a cleaning process such as backwashing.

Efficient filtration will remove a high proportion of contaminants from the water, enhancing the effectiveness of the disinfection process.

An additional role of the circulation system is to provide a continuous flow of water through the water body, to mix and evenly distribute the disinfectant chemicals throughout the water.

Filtration systems shall be designed to take into account the level of contaminants in the water, determined by factors such as the type of facility, the expected bather loading, water depth, the size of the facility, the water volume and operating water temperature.

3.3.2 Filtration Rates and Turnover Times

Aquatic facilities shall be provided with filtration systems appropriate to the category approved by the EDPH. Each body of water shall be equipped with a filtration system that has the capacity to achieve the turnover times set out in the "Water Body Loading Category Chart" (Table 4).

All filtration rates shall comply with the requirements as set out in the “Water Body Parameters by Category Chart” (Table 5).

Table 5 - Water Body Parameters by Category Chart

Category	Maximum Peak Bather Loading (persons/m^2)	Minimum Water Allowance per T/Over (m^3/person/turn over)	Maximum Daily Bather Load (persons/m^3)	Maximum Sand Filter Flow Rate (L/min/m^2)	Maximum D.E Filter Flow Rate (L/min/m^2)	Maximum Cartridge Filter Flow Rate (L/min/m^2)
1	1 person / 1.0m^2	10.0	9.6	400	60	12
2	1 person / 2.0m^2	8.0	6.0	400	60	12
3	1 person / 2.0m^2	7.0	3.4	400	60	12
4	1 person / 2.5m^2	6.0	3.0	600	80	15
5	1 person / 2.5m^2	5.4	2.2	600	80	15
6	1 person / 2.5m^2	5.0	1.9	600	80	15
7	1 person / 3.5m^2	4.8	1.4	700	80	15
8	1 person / 3.5m^2	4.8	1.0	700	80	15

Clause 8 at the end of this Section contains an example on the use of data from Table 4 and Table 5 to determine filtration system requirements.

3.3.3 Requirements for Filtration Vessels

Filtration vessels shall be designed and constructed in accordance with the following requirements:

- To achieve a uniform flow of water through the filter bed.
- To be capable of withstanding normal and continuous use without deterioration that could affect the filter or filter operation.
- To permit regular inspection and maintenance.
- To permit adequate and effective cleaning or replacement of the media, to achieve design flow rates in filter and backwash mode.
- To have corrosion-resistant components.
- Where filter vessels permit the accumulation of air in the top of the vessel housing, the filter vessel shall be equipped with an air release system, which evacuates the air automatically.
- To be installed with all necessary pressure gauges and instrumentation.
- To be clearly labelled with model, make, filter area, pressure rating and flow rates (in filter and backwash mode).

3.3.4 Other Requirements

Facilities shall comply with the following requirements:

- Water velocity in pipe work shall not exceed 3 metres per second in discharge piping, and 1.8 metres per second in suction piping.
- Systems incorporating manifolding shall comply with the requirements of AS 1345-1995, *Identification of the Contents of Pipes, Conduits and Ducts*.
- Filtration equipment shall be protected from tampering by unauthorised persons.
- Filtration equipment shall be mounted level on concrete or another surface, which is easily cleanable and non-absorbent.
- Plant room floors shall slope at a minimum 1:50 gradient towards a floor drainage system.
- Each filter vessel shall be installed so that it can be isolated from the recirculation system for repairs and backwashing.
- All water treatment plant shall be installed with sufficient access, to enable them to be inspected and serviced in accordance with manufacturer's specifications and safe working practices.
- Filters cleaned by backwashing shall be provided with a readily observable sight glass, installed on the waste discharge line. Sight glasses shall be of full line diameter and readily removable for cleaning.
- Facilities using cartridge filters shall be provided with a wash-down area, to enable filtration media cleaning, without creating a nuisance and whereby, the onsite disposal of waste-water is undertaken in a manner that has been approved by the local government.

3.3.5 Balance Tank Capacities and Personnel Accessibility

Balance tanks form an integral part of the hydraulic performance of the water treatment system.

Balance tanks shall be sized, to allow for the following:

- Bather displacement based on the maximum instantaneous load rating for the facility.
- Volume of water available to backwash all primary filters at one time.
- A reserve for start-up after backwash, freeboard and wave displacement of not less than 20% above the sum of 1 and 2.

Where entry is possible into a balance tank, it shall be designed in accordance with the requirements of the *Occupational Safety and Health Regulations 1996* (Part 3 Division 8 "Work in Confined Spaces").

3.3.6 Requirements for Water Supply

The water treatment/recirculation system shall be designed, such that all additional water is filtered before it enters a water body for which patrons may have contact through interaction or use e.g. swimming, leisure or free-play. This requirement does not apply to balance, or holding tank's, for which patrons do not have general access or contact.

The water supply for all water features shall consist of filtered, disinfected water obtained from the return side of the filtration system. This requirement applies to water features such as waterfalls, fountains, mushrooms, or other design features through which water enters an aquatic facility.

It is recommended that high volume water features (water slides, rivers etc); draw their water from a filtered and chlorinated supply. However, if any water is drawn from the balance tank directly into a water feature, then the make-up water entering the balance tank, shall be located in a position away from the water feature suction, within the balance tank, and the balance tank water must be maintained at 2 milligrams per litre of free chlorine, and the free chlorine levels must be tested every 4 hours, in accordance with Group 1 manual water chemistry sampling requirements.

[Section 3.3.6 Requirements for Water Supply amended 15 Sep 2008]

3.4 DISINFECTION

The disinfection process involves adding a chemical to the water to destroy micro-organisms, and oxidise chemical pollutants. To prevent transmission of infectious diseases, it is essential that this process achieves rapid destruction of micro-organisms in the water, without harming the bathers. It is also necessary to maintain a sufficient residual disinfectant in the water to rapidly destroy any micro-organisms introduced by patrons or other sources.

Chemical disinfection processes are generally centred on a chlorine or bromine compound, as they are the most effective chemicals that can safely be used in an aquatic facility. They may be used in conjunction with a number of other chemicals or processes (such as U.V. or Ozone) to improve their efficiency and reduce the creation of disinfection by-products.

3.4.1 General Requirements

Aquatic facilities shall be equipped with automatic disinfectant equipment that is capable of maintaining continuous and effective disinfection of the water under all conditions of use.

The equipment shall be capable of maintaining the water chemistry in compliance with the requirements of this Code.

3.4.2 Design and Installation Requirements

Chemical dosing equipment shall be designed and installed to comply with the following requirements:

- Dosing pumps shall be regulated to accommodate varying supply or back pressures, and ensure the feed rate remains constant.
- Control systems with graduated and clearly marked dosage adjustments shall be provided, which are capable of providing flows from full capacity to 10% of such capacity.
- Chemicals shall not feed into the water if the pumping equipment or power supply fails.
- Operation of the system shall cease if there is inadequate flow of water through the filtration system that would prevent the chemicals from being properly dispersed throughout the aquatic facility water body.
- Water shall not be permitted to siphon from the recirculation system to the water treatment solution container. Water treatment chemicals shall not be permitted to siphon from the solution container into the water body.
- Make-up water supply lines installed on chemical solution feeder tanks shall have an air gap or other back-flow prevention device.

3.5 POSITIONING OF INJECTION POINTS

Uncovered gravity sand filters shall have the disinfectant injection point located prior to the filter.

All other filtration systems may have the disinfectant injection point located either prior to, or after, the filters.

[Section 3.5 amended 15 April 2010]

3.6 SPECIAL REQUIREMENTS FOR ELECTROLYTIC SALT CHLORINATORS

As a by-product of this process is the production of hydrogen gas, (which could accumulate in a pressure filter,) Electrolytic Salt Chlorinators shall only be installed downstream of pressure filters.

Electrolytic Salt Chlorinators shall be electrically linked to the main circulating pump, to prevent the chlorinator operating when the main circulating pump is switched off.

Where the electrolytic salt cells are not designed to be located above the filter vessel, gas detectors shall be fitted that will terminate the operation of the chlorinator in the event of a hydrogen gas build-up.

As an Electrolytic Salt Chlorinator cannot respond to instantaneous chlorine demand, a back-up automatic chlorine system shall be installed, using gas, liquid or granular chlorine.

3.7 SPECIFIC REQUIREMENTS FOR OZONE DISINFECTION SYSTEMS

Facilities equipped with ozone water treatment systems shall comply with the requirements in Appendix 4 of this Code.

3.8 WATER HEATING SYSTEMS

All water heating systems shall comply with the provisions detailed in Appendix 3 of this Code.

[Section 3.8 amended 16 May 2011]

3.9 EXPLANATORY NOTES TO SECTION 3

From Table 5 - Water Body Parameters by Category Chart

Category	Maximum Peak Bather Loading (persons/m^2)	Minimum Water Allowance per T/Over (m^3/person/turn over)	Maximum Daily Bather Load (persons/m^3)	Maximum Sand Filter Flow Rate (L/min/m^2)	Maximum D.E Filter Flow Rate (L/min/m^2)	Maximum Cartridge Filter Flow Rate (L/min/m^2)
1	1 person / 1.0m^2	10.0	9.6	400	60	12
2	1 person / 2.0m^2	8.0	6.0	400	60	12
3	1 person / 2.0m^2	7.0	3.4	400	60	12
4	1 person / 2.5m^2	6.0	3.0	600	80	15
5	1 person / 2.5m^2	5.4	2.2	600	80	15
6	1 person / 2.5m^2	5.0	1.9	600	80	15
7	1 person / 3.5m^2	4.8	1.4	700	80	15
8	1 person / 3.5m^2	4.8	1.0	700	80	15

The above chart specifies maximum filter flow rates for aquatic facility water treatment systems. It is the maximum rate at which the water can flow through the filtration medium. Higher bather loadings (number of patrons in the water) produce higher levels of contamination in the water, such as fats, oils and other bodily wastes. To effectively remove these contaminants, the water must pass through the filtration medium at a slower rate.

The chart prescribes eight levels of filter flow rates, for varying bather loading levels. The bather loadings are linked to the facility classifications prescribed in the Water Body Loading Category Chart in (Table 4).

Bather loading levels are prescribed using a maximum peak bather loading and a maximum daily bather loading.

The maximum peak bather loading is prescribed in Column 2 of the Table, expressed as persons per m^2 of the surface of the water body. This can also be described as the instantaneous bather load, and represents the maximum number of people who may use the aquatic facility water body at any one time. The ratios alter according to the category of facility (as defined by Table 4) and the usual water body depths.

Column 3 is the Minimum Water Allowance per Turnover, and corresponds to the maximum number of people permitted in the water body in a 24-hour period. This loading is calculated from the volume of treated water per day, divided by a volumetric allowance per bather. The volumetric allowance varies with the Category selection and a depth factor. This is expressed in volume (m^3) of treated water per turnover, per person, per day.

Column 4 translates this concept into a Maximum Daily Bather Load. This value is the maximum number of patrons allowed in the water body per m^3 of water per day.

Columns 5-7 provide the Maximum Permissible Filtration Rate for each category of facility, for the three commonly used filter technologies. The value is expressed in litres per minute, per m^2 of filter bed surface area.

It should be noted that these are the maximum rates permissible. Lower filter flow rates may be stipulated by the aquatic engineer, as determined by the anticipated bather loading and water quality requirements. The turnover rates stipulated in Table 4 must be maintained at all times.

Example 1

Water Body Dimensions

Area	**250m^2**	**Depth**	**1.0m**	**Volume**	**250m^3**

SCENARIO A

Heated Water, Indoor Pool, Medium Bather Load, Fairly Shallow Water

Category 5 **Maximum Permissible Turnover Time 2 hr = 125m^3/hr**

Instant Bather Load 250m^2 @ 2.5m^2 per person = **100 persons instantaneous load**

Maximum Daily Bather Load

- Turnover = 125m^3/hr x 24 = 3000m^3/24hr
- Allowance = 5.4m^3/person/24hrs **555 persons per day**

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SCENARIO B

The facility proponent requires capacity to deal with a higher daily bather load (650 persons/day).

Instant bather remains at **100 persons instantaneous load**

Maximum daily Bather load **650 persons per day**

Turnover required = 650 x 5.4 = 3510m^3/24hrs
= 146m^3/hr **1.17hr turnover required (1hr 10mins)**

This must be allowed for in design and application. Probably should apply for a ***Category 4*** with a turnover of **1.5hrs** which would allow **667 persons per day**

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SCENARIO C

The facility is designed and built for an instantaneous load of 100 persons, and a daily bather load of 555 persons per day, but regularly has bather loads of 650 persons per day.

The facility owner will be required to decrease the turnover time as in Scenario B, or limit the number of patrons to 555 per day.

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Note: In all cases, the **Instantaneous Bather Load** remains sacrosanct in design and operation.

Example 2

Water Body Dimensions

Area	**500m^2**	**Depth**	**0.6m**	**Volume**	**300m^3**

SCENARIO A

Heated Water, Indoor Pool, Heavy Bather Load, Shallow Water

Category 3 **Maximum Permissible Turnover Time 1 hr = 300m^3/hr**

Instant Bather Load 500m^2 @ 2.0m^2 per person = **250 persons instantaneous load**

Maximum Daily Bather Load
- Turnover = 300m^3/hr x 24 = 7200m^3/24hr
- Allowance = 7.0m^3/persons/24hrs **1028 persons per day**

……

SCENARIO B

Same Pool size but *Unheated Outdoor* Pool, Heavy Bather Load, Shallow Water

Category 4 **Maximum Permissible Turnover Time 1.5 hr = 200m^3/hr**

Instant Bather Load 500m^2 @ 2.5m^2 per person = **200 persons instantaneous load**

Maximum Daily Bather Load
- Turnover = 200m^3/hr x 24 = 4800m^3/24hr
- Allowance = 6.0m^3/persons/24hrs **800 persons per day**

……..

SCENARIO C

Same Pool size but Unheated Outdoor Pool, *Light* Bather Load, Shallow Water

Category 5 **Maximum Permissible Turnover Time 2.0 hr = 150m^3/hr**

Instant Bather Load 500m^2 @ 2.5m^2 per person = **200 persons instantaneous load**

Maximum Daily Bather Load
- Turnover = 150m^3/hr x 24 = 3600m^3/24hr
- Allowance = 5.0m^3/persons/24hrs **667 persons per day**

……

Note: For Scenario A (***Category 3***) the flow rate through the Filter(s) must also be slower.